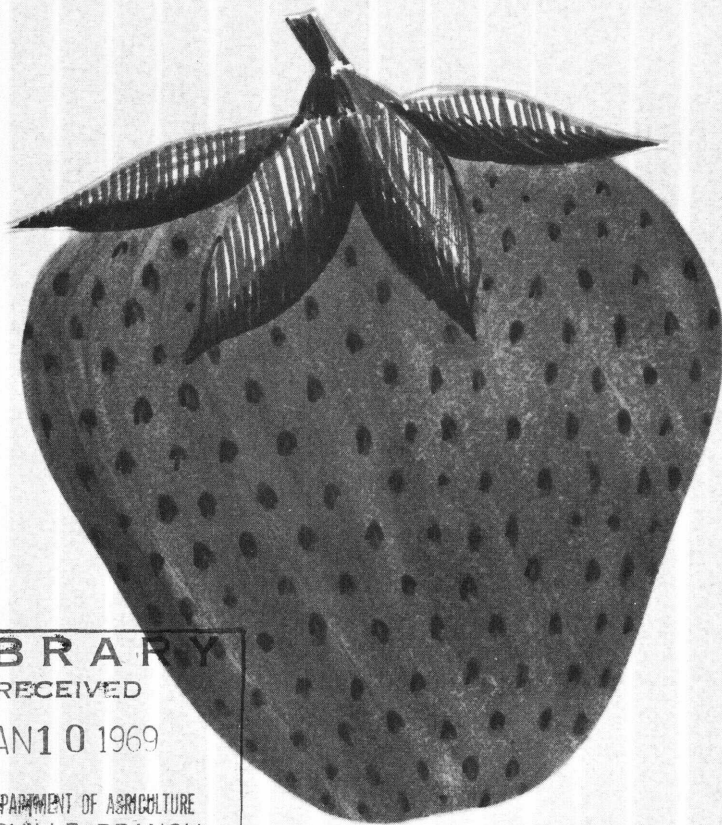


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COMMERCIAL STRAWBERRY GROWING IN THE PACIFIC COAST STATES

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COMMERCIAL STRAWBERRY GROWING

In The

PACIFIC COAST STATES

By GEORGE F. WALDO, *horticulturist*,¹ *Crops Research Division, Agricultural Research Service*, and ROYCE S. BRINGHURST, *geneticist*, and VICTOR VOTH, *horticulturist, Division of Pomology, California Agricultural Experiment Station*

Strawberries are grown throughout the Nation; extensive commercial production is confined, however, to a few states. Approximately 65 percent of strawberry production in the United States is on the Pacific Coast.

High yielding varieties, favorable climatic conditions, and improved farming methods have enabled the Pacific Coast to maintain its position as a leading strawberry growing area in the United States. Rapid air and rail transportation makes it possible for shippers to supply eastern markets with fresh strawberries throughout the summer.

Before you decide to grow strawberries commercially, make sure that—

- Market outlets are available in the area.
- Labor is available during the harvest season.

- The acreage you intend to plant is large enough to make the enterprise profitable.

- The costs of the operation will not be too high. Some of these costs are for equipment, fertilizer, soil fumigation, irrigation, supplies, wages and transportation for pickers, and control of insects and diseases.

GROWING AREAS

Strawberries are grown under many different climatic and soil conditions in the Pacific Coast States. The characteristics of the different growing areas are as follows.

California

Central coast

This area includes Santa Cruz, Monterey, and Santa Clara Counties. In general, the central coast has warm winters and cool sum-

¹ Retired.

mers. Harvest begins in April and continues until stopped by rain, usually in November.

Shasta is the principal variety but Goldsmith and Tioga are also important. Plantings are maintained for 2 to 4 harvest years from winter planting in November and December. Recently summer planting of cold-storage plants about August 1 has become popular.

The plants are always furrow irrigated in summer and are often irrigated in winter.

Verticillium wilt causes considerable damage where soils are not fumigated. Where Shasta is grown, red stele root rot and virus diseases cause little damage. Two-spot spider mites are the most damaging pests in the area.

About half of the strawberries grown on the central coast is harvested for the fresh fruit market and the rest for the frozen fruit market. Most of the freezer fruit comes from the older plantings, which bear smaller fruit than first-year plants.

The plants do not produce runners after the first year partly because of the warm winters. Mulching with clear polyethylene to prevent moisture loss and hasten ripening is gaining in popularity.

Central valleys

This small but prosperous production area is located near Fresno. Winter temperatures are much colder and summer temperatures much warmer than those on the coast. The harvest

season begins in April and lasts about 2 months.

The principal varieties are Fresno and Tioga. All fruit is marketed fresh. The soil is fumigated prior to planting because much of it is infested with verticillium wilt.

All plantings are made in mid-July from cold-storage plants and mulched with clear polyethylene in mid-winter. Plants are generally harvested for only one year.

Santa Maria

This area includes Santa Barbara and San Luis Obispo Counties. In general, winter temperatures are warmer than those of the central coast but summer temperatures are about the same.

Harvest begins in April and continues through the summer and fall until stopped by rain. Slightly more than half the fruit is marketed fresh. The rest is sold to the frozen fruit market.

The principal varieties are Fresno and Torrey. Tioga is becoming more popular. Both summer and winter planting systems are used, and plantings are harvested for more than one season. Plants are usually mulched with clear polyethylene.

The soil generally is fumigated to control verticillium wilt. Two-spot spider mites cause some damage.

Southern California

This area includes the Oxnard coastal plain of Ventura County;

the coastal regions of the Counties of Los Angeles, Orange, and San Diego; and some of the Coachilla Valley.

Production is early because the winters are warm. The principal varieties are Fresno and Tioga. About 60 percent of the acreage is planted in summer and the rest in winter. Winter plantings produce the earliest fruit but summer plantings yield the most.

Crops are planted annually and summer plantings are alternated with winter plantings where the soils are planted to strawberries every year. All summer plantings are irrigated by sprinklers the first year they are planted to minimize salt accumulation. Furrow irrigation does not filter out the salt, but when sprinklers are used the water soaks down through the soil and washes away the salt. During harvest, the plants are watered by furrow irrigation.

The harvest of winter plantings begins in February and ends in August. The harvest of summer plantings begins in March and ends in July or August. Most of the fruit is marketed fresh, but about 25 percent or more is usually sold to be frozen.

Plants are mulched with clear polyethylene in winter. All soils are fumigated.

Oregon

Northern Willamette Valley

This area has the largest acreage of strawberries of any part of the United States. The harvest

begins in late May and continues until early July.

Most of this area has heavy rainfall during winter and little or no rain from June to September. Rains begin earlier and continue later in the foothills of the Cascade Mountains than in the valley. Winter temperatures are colder than in California strawberry growing areas.

High humidity in the hill areas of the Willamette Valley reduces loss of soil moisture. Deep rooting varieties such as the Marshall can be grown without irrigation.

Almost all irrigation in the valley is with sprinkler systems.

Strawberries are grown on the red hills bordering the valley up to elevations of 2,000 feet. Water for irrigation usually is not available at higher elevations.

The principal varieties are Northwest, Marshall, and Siletz. Large processing plants are located in the area, and about 95 percent of the crop is processed by freezing.

Red stele root rot causes damage in some heavy soils, and virus diseases have been serious at times.

Hood River Valley

This area is on the Columbia River in the Cascade Mountains. The climate is similar to the Willamette Valley except there is less winter rainfall, and temperatures are colder in the winter. Strawberry plants are covered with snow in the higher altitudes in winter.

All strawberries are grown for freezing. The principal varieties are Northwest and Marshall. Both furrow and sprinkler irrigation systems are used. Harvest begins in June and continues until mid-July.

Washington

Southwestern Washington

This area includes Clark and Lewis Counties. The climate is similar to the northern Willamette Valley.

Soils in this area are variable, but many are similar to the red hill soils in Oregon. Sprinkler irrigation is used during summer. The Northwest is the principal variety.

Harvest begins in June and continues until mid-July. The berries are grown for the frozen fruit market.

Puget Sound region

The main strawberry producing area in Washington is the Puget Sound region, which extends from Olympia north to the Canadian border. Most of the acreage is in Snohomish, Skagit, and Whatcom Counties. Climatic conditions are similar to those in Oregon.

Northwest is the principal variety. Puget Beauty and Columbia have been grown in recent years by a few growers. The harvest season begins in early June and lasts until mid-July. Sprinkler irrigation is used in summer.

Red stele root rot causes little damage, but virus diseases sometimes are serious.

Eastern Washington

Commercial strawberry growing is not extensive in eastern Washington, but some berries are grown for local markets in Pasco, Kennewick, Walla Walla, and Spokane Counties.

Winter temperatures are colder and spring temperatures are warmer than in western Washington. Irrigation is necessary.

Shasta and Northwest are the principal varieties. The harvest season begins in early June and lasts until mid-July.

MARKET OUTLETS

Market outlets and transportation facilities should be available in growing areas. Facilities for the distribution of fresh strawberries are established in the California producing areas, and processing plants for frozen strawberries are located in California and the Pacific Northwest.

The established market outlets are individual buyers, food processing companies, and grower cooperatives. Independent dealers usually pay for the fruit immediately following harvest, but grower cooperatives often withhold payment until the crop is sold and all expenses paid. Many of the market outlets sell growers strawberry plants, fertilizers, spray materials and dusts, har-

vesting supplies, and specialized equipment. They also supply growers with information on all phases of strawberry growing.

VARIETY SELECTION

The recent increase in strawberry production in the Pacific Coast region is due largely to the origination of especially adapted varieties. The first varieties grown on the Pacific Coast came from the East, but the varieties now grown extensively in the Pacific Coast States originated there.

You should grow varieties that are resistant or tolerant to diseases prevalent in the area, particularly virus diseases, which are widespread along the Pacific Coast. When you grow such tolerant varieties as Shasta and Northwest, they remain productive over a longer period than susceptible varieties.

Red Steele is a serious root rot disease in areas of high winter rainfall. Varieties with some resistance are Siletz, Hood, Puget Beauty, and Columbia. Mildew and leaf spot also cause damage in wet climates; resistant varieties are Northwest, Siletz, and Shasta.

The varieties grown in California are largely for the fresh market. The berries should have uniform shape, good shipping quality, large size, and sweet flavor. Usually, the larger fruit is sold fresh and the smaller fruit goes to the freezer.

THE STRAWBERRY PLANT

The strawberry plant grows from a central stem called a crown whose terminal is a growing point. From this growing point leaves, flower buds, and runners develop. Runners are branches from the main stem. Branch crowns may develop following rapid runner development.

Buds in the axils of the leaves produce flower clusters when temperatures are cool and days are relatively short. Different varieties tend to produce clusters of a particular type. Thus, some varieties produce clusters with many flowers, while others produce clusters with few flowers. Some varieties produce clusters that branch close to the crown while others branch far out on the stem. Clusters with many flowers may produce a large number of berries but the berries may be small.

Strawberry varieties grown commercially in the Pacific Coast States are known as the spring, or June, bearing varieties. They produce flower buds in late summer or autumn and then flower and fruit the following spring.

In Oregon and Washington, the main market outlets are for frozen strawberries. Berry size is not important in the frozen pack since the market prefers medium and small fruit. However, small sized fruit is expensive to harvest.

In California where strawberries are harvested throughout the growing season, select a variety that will give high production during the entire period. In the Pacific Northwest where the fruiting season is short, production usually lasts only about 3 to 6 weeks. In both areas, the variety you select should give large total production during the harvest period.

In the Northwest, early flowering varieties often are injured by late spring frosts. Mid-season varieties, therefore, are considered more reliable.

Many varieties, such as Siletz, produce many berries on a single flower cluster. The first two or three berries normally are large and the rest small. Varieties of this type usually produce a high percentage of berries that are too small to sell even though the total yield often may be very high.

Some varieties, particularly those with a long harvest period such as Shasta and Marshall, do not have many berries per cluster but they are usually large.

You must depend on varieties that are adapted to your area. No single variety has proved satisfactory over a large area, and even those that are best adapted have some serious weaknesses. Study the varieties grown in your area and select the one that best suits your operation.

The principal varieties grown in California are Shasta, Solana, Fresno, Torrey, Tioga, and Goldsmith. Oregon and Washington

varieties are Marshall, Northwest, Siletz, Cascade, Columbia, Hood, Molalla, and Puget Beauty. About 80 percent of the acreage in Oregon and Washington is planted in the Northwest variety.

For a description and discussion of varieties, see Farmers' Bulletin 1043, "Strawberry Varieties in the United States." Ask your county agricultural agent for a free copy or write to the Office of Information, U.S. Department of Agriculture, Washington, D.C. 20250. Send your request on a post card. Include your ZIP Code.

SUITABLE SITES

Gentle slopes are best for strawberries because they provide good water drainage and air movement. Drainage may not be satisfactory on level land. On slopes that are too steep, however, soil erosion can be serious and cultivation expensive.

Although soil moisture may be more uniform and the soil deeper in low areas, cold air settles there and frosts can cause severe damage. Hilltop soils are often thin, lacking in fertility, and exposed to wind that causes the soil to dry out quickly. Also, plants on hilltops are more likely to be injured by cold north winds in winter.

Strawberries on northern slopes ripen later, and the yields may be much larger, than those on southern slopes. This is because north-

ern slopes are cooler and provide more uniform moisture and usually have deeper soil.

Areas that are surrounded by trees or buildings may not have good air movement. Diseases may be serious in such places, and frosts may injure blossoms on cold nights in spring.

You can grow strawberries on many different soil types. Certain varieties may be well adapted to heavy clay soil while others grow well on light, sandy soil if it is fertile. Generally, however, strawberries grow best on fertile, well-drained, slightly acid, loam soils.

Slightly acid soils are common in the strawberry growing regions of Oregon and Washington but not so common in California. Salinity often is a problem in areas of California and eastern Oregon and Washington that have low rainfall and poor drainage.

The alluvial soils of river valleys are suitable for strawberries if located where flooding does not occur. These soils are usually deep, easy to work, and well drained. Many strawberries also are grown on the red hill soils bordering the valleys in Oregon and Washington. Some of these soils lose their fertility rapidly. Do not plant strawberries on poorly drained heavy soil, light sandy or gravelly soil that is not fertile, or thin soil underlaid with rock.

In selecting a soil for strawberry production, you should consider the crops that were previously grown on it. Insects and

diseases that attacked the previous crop may also attack strawberries. Verticillium wilt organisms attack potatoes and tomatoes and will also attack strawberries. This disease has been very serious in California, and all land intended for strawberries must be fumigated before planting. Fumigate with chloropicrin and methyl bromide in combination under a polyethylene cover. Use 350 to 400 pounds per acre of 40 percent methyl bromide and 60 percent chloropicrin.

Verticillium wilt is also serious in many areas of the Pacific Northwest, and it may attack strawberries following crops of black raspberries, hops, and mint.

Armillaria root rot is a disease of tree fruits, but it may also attack strawberries. Weevils and cane borers may pass from raspberries to strawberries. Symphytans, nematodes, and white grubs may also be present in the soil and cause serious damage to strawberries. When these pests are present you must take control measures before you plant strawberries to prevent severe losses.

Poorly drained, heavy clay soils may easily become infested with red stele root rot. This disease spreads through the water in the soil during the rainy winter months and is especially serious in Oregon and Washington. Do not select heavy clay soil for strawberry production. Some varieties are tolerant to the attacks of red stele root rot.



BN-31251

Methyl bromide and chloropicrin fumigant is applied under a polyethylene tarp in California.

PREPARING THE SOIL

In many areas, particularly in the Northwest, continuous cropping has depleted the soil of plant nutrients and organic matter and has left the soil in poor physical condition. A hardpan, or plow sole, often develops just below the level of cultivation. Often you must give these old cultivated soils a program of soil improvement to increase the organic matter and make plant nutrients available.

The use of barnyard manure is one of the quickest and most effective ways of improving soil for strawberries. Applications of

from 10 to 40 tons of manure per acre usually are effective. You also may use poultry manure but at a lower rate. Whenever manure is available, you should use it in preparing soil for strawberries.

Some growers have objected to the use of manure because of infesting the soil with weed seeds. This objection is partly overcome by the use of chemicals for weed control. Practically all growers use chemicals for weed control in the Pacific Coast States.

Grasses and meadow crops are probably the most effective means of increasing organic matter in soil. The grass roots penetrate the soil thoroughly and deeply,

and after the grass grows for 3 to 5 years, a good sod develops. When you plow this sod under, it improves the physical condition of the soil by distributing organic matter throughout the plow layer. In many parts of the West, alfalfa, clover, and other legumes have been used. Plowing under vetch, oats, rye, wheat, barley, sudangrass, or peas has been effective. When the soil is poor, you may need to plow under two or three such crops before strawberries are planted.

Plow the soil carefully before planting. Plow deeply and work the soil thoroughly with a disk so large air spaces will not be left. If the soil is very loose, you

may need to lightly roll or pack it so you can set the plants firmly. Prepare the soil as thoroughly as you would for grain or vegetables.

You must prepare the soil thoroughly for fumigation to control diseases and soil insects, particularly symphylans in Oregon and Washington. The fumigant must penetrate the soil thoroughly or it will not kill symphylan organisms.

You will need special equipment to apply the fumigants, usually a chisel type applicator. Since fumigation methods and materials are constantly changing, consult your county agricultural agent for information on fumigation practices.



BN-31255

Equipment used in Oregon to fumigate strawberry plantings for symphylan control.



BN-31257

Effect of fumigation of the soil on the growth of strawberry plants: Left, fumigated; right, not fumigated.



BN-31253

Systems of planting strawberries: Left, single row; right, double row.

Crop residues should be removed, burned, shredded, or worked into the soil. Subsoiling is usually necessary if the soil is heavy or a hardpan is present. The subsoiling should be done when the soil is dry. Following subsoiling, the soil should be thoroughly disked or rototilled.

Where the furrow method of irrigation is used, leveling is necessary for water to be uniformly distributed over the field. After you level the soil, ridge it into raised beds so you can set the plants on the beds and use the furrows between for the distribution of water.

PLANTING SYSTEMS

In California, the most common method of planting is to set double rows of plants on raised beds. The beds are spaced about 38 to 44 inches from center to center. The rows in each bed are spaced 8 to 12 inches apart, and

the plants in each row are set about 8 to 14 inches apart. Sometimes, single rows on raised beds are used. These beds are spaced 30 to 36 inches from center to center.

If production is for one year only, yields are generally higher on summer plantings when the double row system is used than with the single row system. This is because salt accumulation is greatest in the center of the beds. In contrast, winter plantings in the single row system generally yield more than those in the double row system because more ground surface is exposed to the sun and the bed is warmer during the winter. Also salt accumulation is less because the plants are in the beds for a shorter time.

In the Pacific Northwest, growers use single rows on beds 39 to 42 inches apart with the plants 12 to 15 inches apart in the rows. This method produces high yields under irrigation; and it is less ex-

Plants per acre at different planting distances

Spacing		Plants per acre	
Between beds (inches)	Between plants (inches)	Single Row	Double row
36	12	14,520	—
36	15	11,616	—
39	12	13,403	—
39	15	10,993	—
42	8	18,699	37,398
42	10	14,966	29,932
42	12	12,446	24,892
42	14	10,662	21,324

pensive than the double row system for controlling runners and harvesting berries.

The table on page 13 gives the number of plants required per acre using the different planting distances. The double row system probably would not be used when beds are only 36 or 39 inches apart.

OBTAINING PLANTS

Most plants used in commercial plantings on the Pacific Coast are grown in nurseries. The plants should be obtained from fields grown from first year plants. The nursery plantings should be handled so that insect and disease pests have been controlled. Cold storage plants are generally used in Oregon and Washington, and

these plants must be dug while fully dormant in mid-winter.

Nearly all nursery-grown plants are certified by state agencies as free of diseases and insects. In Oregon and Washington, plants are sold in boxes of 1,000 and in California, in boxes of 2,000.

PLANTING

Planting requires careful attention to assure a full stand and subsequent large yields. Remove all old leaves; and if the weather is warm, remove all expanded leaves. Removal of expanded leaves prevents the plant from losing moisture until it gets established. Many growers cut off the long roots 4 inches below the crown so the roots can be set well down in the soil.



BN-31256

Setting strawberry plants with machines in the Pacific Northwest.



BN-31254

Opening narrow trenches for setting strawberry plants by hand in California.

Many large strawberry growers use planting machines. These machines set the plants at the proper distance apart and at the proper depth. Adjust the machines so the plant roots are set well down into the soil and the soil is firmed against the crown at the ground line between the roots and leaves. Only a furrowing disk that opens a narrow trench is used in California and the plants are set by hand.

When you set the plants by hand, use a spade, shovel, or trowel to make an opening in the soil. Then set the strawberry roots well down into the opening. Press the soil firmly against the roots so they will not dry out and cause the plants to die. Do

not cover the crown of the plant with soil.

Keep the plants moist during planting. When you take plants out of cold storage, plant them as soon as possible. If planting is delayed, keep the plants in a cool place. Irrigate immediately after planting if the weather is warm and dry. Moderate irrigation with sprinklers is the best method to give plants a good start. You may apply solutions containing a hormone or a fertilizer to help plants start growing quickly. Sometimes growers apply fertilizer, particularly nitrogen, in the irrigation water.

In all areas of California, most strawberry varieties can be summer planted successfully by using



BN-31338

Planting strawberries by hand in narrow trenches opened by machine in California.

cold storage plants. The time of planting is very important; 2 weeks too early or too late can make a crucial difference. Recommended timing ranges from early to mid-July in the central valleys to as late as mid-September for some varieties in southern California.

If you plant a variety too early, the plants will lack vigor, the fruit will be small, and the quality low. If you plant a variety late, the total yield will be small, although fruit size will be large and of good quality. And if you plant extremely late, the plants develop runners as early as March during the fruiting season and produce very light crops.

In California's central coast and the Santa Maria and south-

ern California areas, you may set plants successfully in the winter. However, only plants from high elevation nurseries perform satisfactorily under this system. If grown at elevations of 3,000 feet or above, they receive early seasonal chilling and will grow satisfactorily when winter planted. Also, for best results, apply clear polyethylene bed mulch immediately after planting.

Spring plantings are not recommended in California.

Spring is the usual time for planting in the Pacific Northwest. Plants usually are set in April or May, but occasionally plantings are made in February and March. When the spring-weather has been cold, it may be necessary to set plants as late as June. When

late plantings are made, irrigate the soil immediately to prevent plants from drying out.

Almost all strawberry plants set in the spring produce blossoms. Their removal stimulates growth. However, since this process is expensive, growers do not remove blossoms unless the weather is hot and dry.

When plants grow vigorously after spring planting, some growers find it profitable to pick and market the berries the first year. Some varieties in Oregon will occasionally fruit all summer and still grow vigorously and produce a full crop the following spring.

IRRIGATION

Almost all growing areas in California require frequent irrigation during the summer. The furrow system is used during fruit production. When sprinkler irrigation is used during fruiting, it stimulates fungus rot and makes the fruit unsuitable for shipping to the fresh market.

With the furrow method, considerable effort and expense are needed to prepare the land for even distribution of the water. Land must be leveled, terraced, and ditched; plants are set on ridges with furrows between.

Under sprinkler irrigation, on the other hand, plants can be grown on rolling land where soils vary in depth. Since erosion is not as serious under sprinkler irrigation, light sandy soils can be used if they are fertile.

The sprinkler system is used in western Oregon and Washington. In this area, irrigation is only needed during the dry summer months. The furrow system is used in some areas of eastern Oregon and Washington.

In areas where the soil is sandy, frequent irrigation in summer is necessary, especially if the weather is warm and dry. The heavier soils of the Pacific Northwest usually do not need irrigating oftener than every 2 or 3 weeks during the rainless period in summer. Enough water should be applied each time to thoroughly wet the soil through to the subsoil moisture. About 2 inches is usually sufficient for each application. Less water can be applied to sandy soils, but it should be applied more frequently and always following harvest.

WEED CONTROL

Herbicides are now commonly used to control weeds. However, since materials used, time of application, and methods are changing rapidly, no standard recommendations can be made. You can obtain information on the use of chemicals from your county agricultural agent or your State agricultural experiment station.

Usually your plants will need some cultivation and hoeing because some weeds escape control by chemicals. Whenever it is necessary to cultivate, disturb only the surface inch or two of soil. Strawberries are shallow rooted,

and deep cultivation destroys roots needed to support growth of the plants.

FERTILIZERS

Although you should grow strawberries only on the most fertile soils, you still need to use some commercial fertilizer to obtain the highest yields. Soil tests and experience in growing are the best guides to fertilizer needs.

Strawberries grown in the Pacific Coast States usually respond to nitrogen fertilizers. California soils rarely need anything but nitrogen. Too much nitrogen causes excessive growth of foliage and runners. This, in turn, reduces yield. As you increase the nitrogen rate, the plants grow faster and the amount of phosphorus and potash they can obtain may become deficient.

The soils of Oregon and Washington are often deficient in other elements besides nitrogen. Phosphorus is often needed; potassium, sulfur, boron, and magnesium are sometimes needed. Lime is beneficial when the soil is very acid.

Do not apply nitrogen in the spring in Oregon and Washington unless the plants are weak and unless you know there is a deficiency. Nitrogen stimulates plant growth that makes the berries soft and lacking in flavor. Nitrogen is beneficial following harvest in Oregon and Washington and during July if the plants can be

irrigated. If irrigation is not available, delay applying nitrogen until the fall rains begin.

You may apply phosphate fertilizers at planting time. To be effective, you should apply them in bands on both sides of the row 3 to 4 inches from the plants and 4 to 6 inches deep. You may broadcast boron and potassium fertilizers. Apply nitrogen as a urea spray or broadcast it in pellet form.

RUNNER CONTROL

In California, runners usually are easy to control when strawberries are bearing continuously all summer. The plants do not grow runners when they produce an abundance of fruit. Most varieties produce runners on first-year summer plantings. The runners on these plants must be removed.

Runner control is difficult in the Northwest where fruit production lasts only a short period in the spring. When you use the matted bed system, plants often become too thick with runners, and yields are lowered. By reducing bed width to 8 to 12 inches with sharp disks, you get higher yields than in wide matted beds.

You can use spaced rows without much work if you grow a variety that does not produce many runners. Space the mother plants 15 to 18 inches apart and their runner plants 6 to 8 inches from each other and from the mother plants. Spaced rows may give very high yields.

Occasionally varieties are grown that produce large single plants but not many runners. Set the plants about 3 feet apart in each direction and cultivate in each direction. Many strawberry growers in the Northwest set plants 12 to 15 inches apart in a single row and cut off all runners. Since cutting runners by hand is expensive, growers use machines to throw the runners into the row and cut them off.

CARE BEFORE HARVEST

If weeds and grass grow during the winter, remove them in the spring before picking begins. You can spray, dust, or bait with chemicals to control diseases and insects. Since chemicals and methods of applying them change from season to season, you should see your county agricultural agent for information on their use.

Spring frosts can seriously damage strawberries in bloom. Usually, you can protect blooms from light frost damage by irrigating with sprinklers when temperatures are below freezing. Various types of orchard heaters have been used, but these are not as effective as with tree fruits.

HARVESTING

All strawberries are picked by hand. No machine is available commercially that can remove the berries from the plant at the right

degree of ripeness without injuring them. In California, the stem is always removed completely. The only exception is when long stemmed fruit is picked for specialty sale. If you leave short stems, they puncture the soft fruit and expose the flesh to rot.

You must pick the berries at the right stage of ripeness. Over-ripe berries are soft and easily injured in marketing. Immature berries do not have good flavor and appearance.

Weather conditions usually determine the frequency of picking. Berries ripen fast in warm weather and slowly in cool weather. Normally, you should pick berries about every 4 or 5 days during the harvest season. Pick them early in the day. Berries are firmer and easier to handle when they are cool than when they are picked in the heat of the day.



BN-31259

Picking strawberries by hand. Machines cannot be used.



BN-31260

A mobile berry shed where strawberries are collected in the field as they are picked.

California berries are picked both for the fresh market and for freezing. Pickers are provided with containers to hold berries for the fresh market, other containers to hold berries for the freezer, and a small three-wheeled cart on which to transport the berries in the field.

Berries picked for the fresh market are placed in cups of perforated plastic or fiberboard that hold up to 1 pound of fruit. Pickers carry the cups in trays that hold 12 cups. A tray usually contains 11 to 12 pounds of berries.

In the Pacific Northwest, berries are harvested without caps for the frozen fruit market. Pickers place them in cups (hallocks) of wood veneer or fiberboard containing about 1 pound of berries. They transport the berries in carriers holding six to eight 1-pound hallocks.

CARE AFTER HARVEST

In Oregon and Washington, removing the leaves immediately following harvest often increases yields the next year. Various means have been used, but a rotary mower is most satisfactory. Burning the leaves is a common practice. Chemical treatments are unsatisfactory because the crowns of the strawberry plants are often damaged.

The advantages of removing the leaves are that you can apply irrigation water more uniformly, and weed control and fertilizer application are easier. After you mow the plants they pro-



BN-31258

Cart used by pickers to transport strawberries in the field.



BN-31252

Trimming old leaves from strawberry plants in California.

duce a quick, vigorous growth of new leaves needed for a good crop the following year.

You should not remove the leaves from plants the first year in the Pacific Northwest.

When the matted row system is used, cut the width of the rows to 8 to 12 inches in late summer by using sharp disks or a rotovator.

During summer and autumn, plants should be irrigated, fertilized, and weeded. Growers in Oregon and Washington can often maintain high production for as many as four or five harvest seasons by using good after-harvest practices. Most growers allow their fields to stay in production for at least three seasons. About one-third of the total acreage is replanted each year.

In summer plantings in California, remove the old leaves about January of the first winter just before you apply the polyethylene bed mulch. Do not disturb crowns and young leaves. Leaves are not removed from winter plantings because all the leaves are new. After the first year, remove all the leaves during the winter if the plants are to be held for another harvest. Oil sprays are often used to kill the old leaves so they are easier to remove from old plantings.

Clear polyethylene bed mulch is essential to successful strawberry growing in California. It takes much of the gamble out of winter planting by increasing the soil temperature as much as 10° F. during the short winter days. Often this means the difference



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Strawberry plants mulched with clear polyethylene in California to force early ripening.

between vigorous growth and very little growth. When you use polyethylene, the fruit ripens early, the harvest is large, and the length of the harvest season is long.

In winter plantings, apply clear polyethylene mulch immediately after planting. In summer plantings, do not apply the mulch until mid-winter except when planting is late. Then you should apply it earlier. The benefits are somewhat the same as with winter plantings. In both cases, fruit quality is improved, harvesting is easier, and fruit rot damage is lessened. When you remove a planting from a field, remove the polyethylene. Do not cut it up and work it into the soil.

Always use clear polyethylene. Black polyethylene is generally

unsatisfactory because it shades the soil and retards the desired mid-winter heating of the soil which promotes early bearing.

HOME GARDENS

Strawberries often are grown in home gardens for family use. The practices used by commercial growers apply in general to home gardens. Many home gardeners have trouble growing strawberries because they are not familiar with soil and fertilizer requirements and with diseases and insects. Diseases and insects often give more trouble in home gardens than in commercial fields.

Many home gardeners grow ever-bearing varieties that fruit during the late summer months.

These produce the best when plants are set out each spring and the blossoms removed up until about July 1. By not allowing the first blossoms to develop fruit, the new plants rapidly build up for highest production during the rest of the summer.

In some areas of California, commercial varieties fruit all summer and home gardeners may use these as well as the ever-bearing varieties. Even in Oregon and Washington, such varieties as Shasta will often fruit as satisfactorily as everbearers. Ever-bearing varieties that are usually satisfactory are Rockhill, Red Rich, Gem, and Mastodon.

The number of plants needed depends on the desires of the family. From 50 to 200 plants are enough for most families.

Home gardeners often find mulches convenient to keep down weeds and prevent the soil from washing onto the berries during irrigation. For this purpose, polyethylene is best but sawdust, wood shavings, lawn clippings, or leaves also may be used.

DISEASES AND INSECTS

Several diseases and insects attack strawberries in the Pacific Coast States. For information on them, see your county agricultural agent or state agricultural extension service, or write the Office of Information, U.S. Department of Agriculture, Washington, D.C. 20250. Ask for a free

copy of FB 2140, "Strawberry Diseases," and FB 2184, "Strawberry Insects, How to Control Them." Send your request to the Department on a post card. Include your ZIP Code in your return address.

PRECAUTIONS

Pesticides used improperly can be injurious to man and animals. Use them only when needed and handle them with care. Follow the directions and heed all precautions on the labels.

Some States have special restrictions on the use of certain pesticides. Before applying pesticides, check State and local regulations.

Keep pesticides in closed, well-labeled containers in a dry place. Store them where they will not contaminate food or feed, and where children and animals cannot reach them. Promptly dispose of empty pesticide containers; do not use for any other purpose.

When handling a pesticide, wear clean, dry clothing.

Avoid repeated or prolonged contact of pesticide with your skin.

Wear protective clothing and equipment if specified on the container label. Avoid prolonged inhalation of pesticide dusts or mists.

Avoid spilling a pesticide on your skin, and keep it out of your eyes, nose, and mouth. If you get a pesticide on your skin, wash it off

immediately with soap and water. If you spill a pesticide on your clothing, remove the clothing immediately and wash the skin thoroughly. Launder the clothing before wearing it again.

After handling a pesticide, do not eat, drink, or smoke until you have washed your hands and face. Wash any exposed skin immediately after applying a pesticide.

Avoid drift of pesticide to nearby wildlife habitats, bee yards, crops, or livestock. Do not apply pesticides under conditions favoring drift from the area to be treated.

Many pesticides are highly toxic to fish and aquatic animals. Keep pesticides out of all water sources such as ponds, streams,

and wells. Do not clean spraying equipment or dump excess spray material near such water.

Do not apply pesticides to plants during hours when honey bees and other pollinating insects are visiting them.

Have empty pesticide containers buried at a sanitary land-fill dump, or crush and bury them at least 18 inches deep in a level, isolated place where they will not contaminate water supplies. If you have trash-collection service, thoroughly wrap small containers in several layers of newspaper and place them in the trash can.

It is difficult to remove all traces of herbicides from equipment. For this reason, do not use the same equipment for applying herbicides that you use for insecticides and fungicides.